Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

Office of Engineering and Technology Requests Information on Use of 1675-1710 MHz Band	)))	ET Docket No. 10-123

COMMENTS OF RAYTHEON COMPANY

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Raytheon Company, by its attorneys, submits its comments in response to the Public Notice of the Office of Engineering and Technology ("OET"), dated June 4, 2010,[1] seeking information on the current use of the 1675-1710 MHz band by non-federal entities, the impact of any potential changes in the allocation of this spectrum, and the band's potential utility for mobile broadband use. As explained below, this band is heavily used today to support public safety activities and other public benefit purposes, including critical meteorological-related applications. Consequently, significant issues are raised by any consideration of making this spectrum available for mobile wireless broadband.

I. STATEMENT OF INTEREST

Raytheon Company is a technology company in the defense, aerospace and related government markets operating in the United States and internationally. Raytheon has broad experience in providing environmental solutions covering sensor development; space systems payloads; command, control and communications systems; space mission data processing; space systems operations and maintenance; and information dissemination, including broadcasts and warnings. Raytheon is developing and will operate the ground segment for the country's next generation polar-orbiting meteorological and environmental satellites, which will

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[1] *See* Public Notice, Office of Engineering and Technology Requests Information on Use of 1675-1710 MHz Band, DA 10-1035 (released June 4, 2010) ("Public Notice").

replace the current Polar Orbiting Environmental Satellite ("POES") System. Satellites such as POES transmit data to non-federal as well as federal users on links in the 1675-1710 MHz band, which are a significant resource supporting weather forecasting, timely and coordinated public safety responses to weather and environmental emergencies, generation of scientific data products and specialized warnings, and climate and environmental monitoring among many other uses.

II. INTRODUCTION AND SUMMARY

Of paramount concern to Raytheon as the Federal Communications Commission examines the 1675-1710 MHz band is OET's expectation, stated in the Public Notice, that the band is "relatively lightly used, both geographically and temporally, and thus could be shared by others." As detailed below, and as has been demonstrated by the many early-filed responses in this docket, the 1675-1710 MHz band as currently allocated is heavily used by nonfederal entities and persons. Many forms of meteorological and environmental information are transmitted in this band as well as "All Hazard" data including broadcast warnings and post-event bulletins related to natural dangers, environmental disasters, fires, nuclear incidents, terrorist activities, and public safety matters (*e.g.*, Amber Alerts). Non-federal organizations wishing to receive these transmissions can equip themselves with a receiving earth station, without requesting authorization from the government satellite operator or from the Commission, making it impossible to readily determine how heavily the band is used. As the comments filed early reveal, these users and other concerned parties include state and municipal agencies (including natural resources and emergency management agencies),[2] universities,[3] cities,

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[2] *See, e.g.*, Comments of Janet Bly, General Manager, Miami Conservancy District; Comments of the City of Portland Water Bureau; Comments of Ralph L. Seanga, Jr., General Manager, Upper Arkansas Water Conservancy District; Comments of the Water Resources Department for the City of Mesa, Arizona; Comments of Karen L. Smith,

municipalities, and tribal governments,[4] professional associations,[5] the World Meteorological Organization, EUMETSAT and other intergovernmental organizations,[6] public interest groups,[7] and several companies.[8] As these comments indicate, the band is used and its transmissions are monitored by non-federal and federal users throughout the United States (and others throughout the world) continuously, 24 hours per day, 7 days per week, and 365 days per year.

For reasons explained below, sharing the satellite downlinks in the 1675-1710 MHz band with terrestrial broadband users would be difficult if not impossible. Based on current heavy use by non-federal users – both geographical and temporal – and the incompatibility of shared use, OET and the Commission should conclude that mobile broadband

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Deputy Director, Arizona Department of Water Resources; Comments of Wayne Gannett, P.E., Hydraulic Engineering Unit, New York State Department of Transportation; Comments of James Mathew May, Assistant Director, Operations, Johnson County, Kansas Emergency Management and Homeland Security; Comments of Steve Rosa, Deputy Emergency Management Coordinator, Brazoria County, Texas, Office of Emergency Management; Comments of Dennis Vidmar, Director, Bellevue Utilities Department, City of Bellevue, Washington.

3 *See, e.g.,* Comments of the University of Wisconsin–Madison, Space Science & Engineering Center; Comments of IndianaView; Comments of the University of Maine; Comments of the University of Delaware, College of Earth, Ocean, and Environment; Comments of Louisiana State University, Earth Scan Laboratory; Comments of the University of South Florida; Comments of Colorado State University, Cooperative Institute for Research in the Atmosphere; Comments of Paul Ruscher, Acting Program Director, Florida State University; Comments of the University of California–Santa Barbara, Computational Earth System Science and Marine Science and Geography Department.

4 *See, e.g.*, Comments of Fort Bend County, Texas; Comments of the Tulalip Tribes of Washington.

5 *See, e.g.*, Comments of the New York State Floodplain and Stormwater Managers Association; Comments of the Association of Metropolitan Water Agencies; Comments of the Mid-Atlantic Coastal Ocean Observing Regional Association.

6 *See, e.g.*, Comments of the European Organization for the Exploitation of Meteorological Satellites.

7 *See, e.g.*, Comments of the Fishing Rights Alliance; Comments of the Northern Plains Resource Counsel Coal Bed Methane Task Force and Tongue and Yellowstone Irrigation District.

8 *See, e.g.*, Comments of Horizon Marine, Inc.; Comments of Morcom International, Inc.; Comments of Roffer's Ocean Fishing Forecasting Service, Inc.; Comments of SeaSpace Corporation; Comments of YSI, Inc.

use of this band is neither feasible nor in the public interest. The Commission should consider other means by which the demand for commercial mobile broadband services might be satisfied to meet the recommendations of the National Broadband Plan and the President's Broadband Initiative.[9]

Raytheon urges the Commission to fully consider the adverse impact that changing the allocation of the 1675-1710 MHz band to allow for mobile broadband use would have on public safety efforts, including, for example, on emergency planning, safety alerts, and disaster planning. While Raytheon recognizes the value of robust mobile broadband for the nation and the economy and that pursuing the goals of the White House's Broadband Initiative and National Broadband Plan inevitably will require certain compromises by certain users of the spectrum, the 1675-1710 MHz band as currently allocated serves vital safety functions which would be gravely endangered if the band is made available for mobile broadband use. In previous cases when the Commission and NTIA were directed by the Congress to consider reallocating federal government spectrum, Congress mandated that these agencies pay particular attention to public safety and avoid degrading the usefulness of critical Federal programs to both federal and non-federal users. The same criteria should apply here. Raytheon urges the Commission to exercise caution and diligence before proposing any changes to the use of the 1675-1710 MHz band that might adversely impact weather disaster emergency management.

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9 *See* Presidential Memorandum: Unleashing the Wireless Broadband Revolution, dated June 28, 2010, located at http://www.whitehouse.gov/the-press-office/presidential-memorandum-unleashing-wireless-broadband-revolution (not yet published in the Federal Register). Raytheon does not make recommendations of other bands (or sub-bands) that might be better suited, as that would go beyond the scope of the Public Notice. Raytheon reserves its rights to comment on the suitability of and the public interest impacts of reallocating any other spectrum band or sub-band that the Commission might propose in the future.

III. RESPONSES TO SPECIFIC ITEMS IN THE PUBLIC NOTICE

Raytheon offers below its specific comments regarding several of the items delineated in OET's Public Notice.

Item 2: Identity of the non-federal entities accessing the services operating in the 1675-1710 MHz band

Currently, many users, both non-federal as well as federal, rely on meteorological and environmental data transmitted in the 1675-1710 MHz band by the following programs:

- Physical Oceanographic Real-time System (PORTS® via the HRPT downlink)
- ARGOS Data Collection System
- Low Rate Information Transmission (LRIT), formerly Weather Facsimile (WEFAX)
- Emergency Managers' Weather Information Network (EMWIN)
- Data Collection System (DCS)
- Geostationary Operational Environmental Satellites (GOES) Variable (GVAR)

Numerous non-federal users such as public safety organizations, universities and other interested entities have procured or constructed receiving equipment to support each of the foregoing services, which have been provided as a public service for many years.[10] Non-federal organizations can equip themselves with an earth station to receive the satellite transmissions without obtaining authorization from or registering with the government satellite operator or the Commission, making it impossible to readily determine precisely how many users there are

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10 Much of the equipment is manufactured in the U.S. http://www.nws.noaa.gov/emwin/winven.htm. Raytheon's discussions with manufacturers of the receivers reveal that today's systems would require expensive modification to attempt mitigating the effects of harmful interference from in-band mobile broadband emissions, changes which are likely to be economically infeasible for the users. *See* notes 2-8, *supra*, providing examples of the plethora of entities that filed early in this docket with concerns about making the band available for mobile broadband, and p. 11, *infra*, describing users of the EMWIN system.

without further investigation. But the numerous comments filed in the docket thus far make it clear that the use is widespread.

The data from the foregoing services provide crucial and instantaneous information about flooding, storms and potential hazards to persons, infrastructure and properties throughout the United States. EMWIN users, for example, include many television stations in the Midwest (especially in tornado prone areas), police stations, fire stations, emergency centers and emergency response personnel, re-broadcasters, schools, storm spotters, amateur meteorologists, and the National Weather Service (NWS) in the Pacific region.[11]

Making the 1675-1710 MHz band available for mobile broadband use would frustrate the ability of these many users to access the vital information downlinked in this spectrum. Today's broadband wireless equipment typically has poor filtering, such that any attempts to share the band will likely increase noise harmonics experienced by users of the band to downlink satellite data, causing them to suffer harmful interference which will drastically reduce the functionality of the programs on which the users (and in many cases the general public) depend today.

In previous allocation scenarios, Congress mandated that the Commission avoid reallocation of federally allocated spectrum in certain circumstances. Specifically, Congress directed that reallocation should not occur if it would cause "(i) serious degradation of Federal government services and operations; (ii) excessive costs to the Federal Government and users of Federal Government services; or (iii) excessive disruption of existing use of Federal Government frequencies by amateur radio licensees."[12] The same criteria should be applied to consider

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11 In addition, foreign meteorological agencies such as the Canadian Meteorological Service, and many South and Central American countries, Caribbean nations, and Pacific Island nations use these services.

12 47 U.S.C. § 923(c).

whether to consider making the 1675-1710 MHz band available for mobile broadband use. In this proposed case, the first criterion will clearly be satisfied as the federal services described above on which many non-federal users rely would be seriously degraded. But there is also the potential that introducing mobile broadband use would impose significant costs on today's non-federal as well as federal users of the band in question, especially in light of the limited budgets of many public agencies, stranding the receive equipment in which they have invested. Because the reallocation of the 1675-1710 MHz to mobile broadband would diminish the capacity of non-federal as well as federal users to receive emergency signals throughout the country, services whose benefits far outweigh any benefit derived from the incrementally expanded broadband capacity that would be achieved by making a portion of this spectrum available for broadband, any future change in allocation would contravene the foregoing statutory criteria and not be in the public interest. The Commission should explore satisfying the demand for expanded mobile broadband capacity available in other spectrum bands or through other means that do not compromise critical applications that support public safety.

Two specific system examples illustrate the critical importance of the current uses of 1675-1710 MHz and the negative impact of introducing mobile broadband use in the band:

a. NOAA's Physical Oceanographic Real-time System ("PORTS®")

NOAA's National Ocean Service is responsible for generating and making available real time oceanographic data and other navigation products to non-federal as well as federal users to promote safe and efficient navigation within U.S. waters. It uses the 1675-1710 MHz band for that purpose. PORTS® is a decision support tool that improves the safety and efficiency of maritime commerce and coastal resource management through the integration of real-time environmental observations and forecasts. It measures and disseminates observations and predictions of water levels, currents, salinity and meteorological information that mariners

require to navigate safely. The coastal resource protection portion includes information on marine accidents and major oil spills. This real-time oceanographic PORTS® system is available in the following locations and their vicinities: Cherry Point, Chesapeake Bay, Delaware Bay, Gulfport, Houston/Galveston, Lake Charles, Los Angeles/ Long Beach, Lower Columbia River, Lower Mississippi River, Mobile Bay, Narragansett Bay, New Haven, New York/New Jersey Harbor, Pascagoula, Anchorage, Sabine Neches, San Francisco Bay, Soo Locks, Tacoma, and Tampa Bay.[13]

Economic benefit studies of the NOAA PORTS® system were prepared by the Woods Hole Oceanographic Institute Marine Policy Center on three of the above port locations. Direct annual benefits to the Houston Galveston Bay area are $14.1 to 15.6 million dollars, direct annual benefits to the Tampa Bay area are $2.4 to $4.8 million dollars, and the Lower Columbia River region in Washington State receives $6.4 million dollars in annual benefits from the NOAA PORTS® system.[14]

b. ARGOS Data Collection System

The ARGOS Data Collection System transmits, using 1675-1710 MHz frequencies, essential wildlife and environmental monitoring data collected from ocean buoys and often otherwise unobtainable to research and protection communities. ARGOS was developed under a Memorandum of Understanding between the Centre National d'Etudes Spatiales ("CNES"), NASA, and NOAA. The system utilizes both ground and satellite-based

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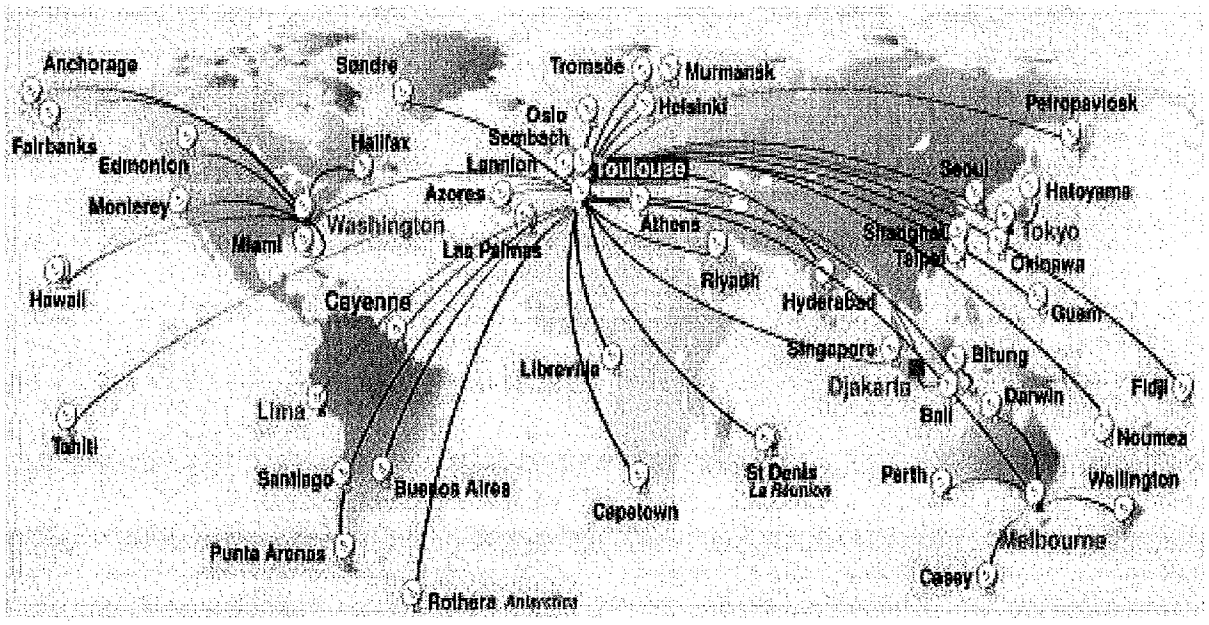
13 *See* http://tidesandcurrents.noaa.gov/ports.html for further information on the PORTS® system.

14 "Estimating Economic Benefits from NOAA PORTS® Information – A Case Study of the Columbia River."; "Estimating Economic Benefits from NOAA PORTS® Information – A Case Study of Houston/Galveston," "Estimating Economic Benefits from NOAA PORTS®S Information – A Case Study of the Tampa Bay" may be found at http://tidesandcurrents.noaa.gov/pub.htm. Technical details of the economics analysis may be found in NOAA Technical Report NOS CO-OPS 044.

resources to accomplish its mission. This includes instruments carried aboard the NOAA polar-orbiting environmental satellites ("POES"),[15] sixty (60) receiving stations in the U.S. and around the world and major processing facilities in the U.S. and France. The nearly sixty L-band non-federal receiving stations, distributed worldwide to provide coverage, are a key element of the ARGOS service.[16] See the figure.



The environmental monitoring from the ARGOS system, which has been in operation since 1978, supports the understanding of climate change, enables *in situ* observations for operational oceanography and meteorology, it protects biodiversity of thousands of animals,

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15 Polar orbiting satellites transmitting to ground stations require that ground stations be able to point in all azimuths and at all elevations in order to receive the satellite transmissions, as the satellites will have pass-overs that begin and end at many points on the compass over a multi-day cycle (even if they are generally pass-overs in either a north-east to south-west or south-east to north-west direction.) As such, earth stations receiving signals from systems such as POES and the next generation polar-orbiting system Raytheon has been supporting will point in all directions, and any measures designed to protect such stations from co-channel or adjacent channel interference must take these operating characteristics into to account.

16 Although some web-based references state there are fifty (50) stations, sixty (60) are currently in the network in preparation for the next generation. *See* http://www.argos-system.org/manual/index.html#2-system/24-stations.htm.

birds, fish, marine and land animals, it protects public health in developing countries by monitoring school attendance and food distribution data, it supports international aid organizations to better monitor and manage aid programs and prevent humanitarian crises, it supports improved maritime security, and it plays an important role in helping scientists and governments understand oil spills and track the movement of such spills.

The ocean buoy data are fed directly (via 400 MHz uplinks) to remote sensing satellites and used in the marine weather forecasts that are critical for government and non-government ships at sea. These transmissions are the only source of information available to allow the forecasters to make accurate predictions. Satellites relay this data back to earth stations distributed worldwide in the 1675-1710 MHz band as shown above. Satellite transmission in the 1675-1710 MHz band is the only viable mechanism for these users. ARGOS provides data on atmospheric pressure, sea temperature, alarm management for river water levels and related data. Surface pressure data provided by sensors, and received by ARGOS, are assimilated into the inputs used to create global weather forecasts via numerical weather prediction. Surface pressure is essential for understanding the boundary layer, for weather and hurricane forecasting. During hurricane season, buoys are deployed downstream from hurricanes, and those data are collected and specifically used to predict where hurricanes make landfall. ARGOS helps the scientific community better to monitor and understand the environment, and it helps industry to comply with environmental protection regulations implemented by government.[17]

ARGOS is also the system of choice for biological tracking; virtually all animals that are tracked via satellite are done so with the ARGOS system. One of the key benefits from

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[17] *See* http://www.noaasis.noaa.gov/ARGOS/index.html and a list of receiving stations at http://www.argos-system.org/manual/index.html#2-system/24-stations.htm.

the marine community, is that scientific data are essential to the process in developing management techniques and procedures for fisheries and species preservation.[18]

A new generation ARGOS-3 system has already been launched aboard EUMETSAT's MetOp satellite. The ARGOS-3 system introduces two-way communication capability and a greater volume of data transmitted during each satellite pass. ARGOS-3 will utilize an upgraded ground network at L-band to relay data from the satellites to the processing centers.[19]

Item 3: A description of the purpose of such use (*i.e.*, the equipment is used to support TV weather forecasting or for conducting university research)

General descriptions of each program identified in response to Item 2 above (and not already discussed in detail in Item 2) are provided below.

a. Low-Rate Information Transmission System (LRIT). The LRIT system is an international standard for data transmission for digital meteorological satellite broadcasts. LRIT data products include imagery from visible and infrared satellite sensors, water vapor data, tropical storm products from the NOAA/NWS Hurricane Center, and graphic data from certain foreign meteorological satellites – METEOSAT from the European Union and MTSAT from Japan.

b. Emergency Managers Weather Information Network (EMWIN). EMWIN is an inexpensive but important warning system enabled by the GOES family of satellites for the emergency management community to use during natural and manmade disasters. More than ten thousand emergency managers throughout the U.S. rely on data from

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18 ARGOS also plays an important role in recovery of maritime vessels that have been hijacked.

19 For further information on applications of ARGOS, *see* "ARGOS-3 The New Generation" at http://www.argos-system.org/html/system/enhancements_en.html.

the EMWIN network. EMWIN is supported by the NWS in partnership with NOAA's National Environmental Satellite, Data and Information Service (NESDIS) and other public and private organizations. EMWIN was developed to provide the emergency management community with access to a set of NWS warnings, watches, forecasts and other products at no recurring cost.

EMWIN consists of a suite of data access methods which make available a live stream of weather and other critical emergency information in the 1675-1710 MHz band. The service uses push technology, and relatively inexpensive demodulators for receipt by users of the EMWIN signal via radio. After the data are downlinked downlinked from the GOES family of satellites, received weather products are displayed on a personal computer. EMWIN provides for the dissemination of alerts and warnings in less than 1 minute, forecasts in two to five minutes, and graphics and imagery in ten to fifteen minutes. EMWIN users include many television stations in the Midwest, police stations, fire stations, emergency centers and emergency response personnel, re-broadcasters, schools, storm spotters, amateur meteorologists, National Weather Service in the Pacific region. EMWIN is also used by foreign meteorological agencies such as the Canadian Meteorological Service, many South and Central American countries, Caribbean nations, and Pacific Island nations. EMWIN is rebroadcast by the PSAT (175° W.L.) and Asiastar (103° E.L.) satellites. EMWIN is often the only weather system still functioning after a severe weather event and provides advance warning of tsunami and typhoons for the Pacific region. Many users rebroadcast the data via localized VHF systems, such that the data are used in multiple locations, and the end user may very well be unaware that 1675-1710 MHz band is used to support the receipt of the data on which they rely.

c. Data Collection Systems (DCS). Two DCS systems utilize the 1675-1710 MHz L-band frequencies – the ARGOS Data Collection System (discussed in detail above)

and the GOES Data Collection System. Both are satellite-based systems which collect, process, and disseminate environmental data from fixed and mobile platforms worldwide. ARGOS is global in coverage, and GOES DCS covers the Western Hemisphere between 70 degrees north and 70 degrees south. (Coverage for the GOES DCS can be worldwide if agreements are made between administrations.)

The GOES program supports an environmental data point-to-point radio relay DCS. The DCS allows a remote radio set or Data Collection Platform (DCP), which is land, sea or mobile-based, to transmit through the GOES system and back to the NESDIS Wallops Command and Data Acquisition (CDA) Station at Wallops, Virginia, from where these data are selectively routed to appropriate system users via communications links. GOES DCS was made operational more than thirty years ago. Transmission centered on 1683 MHz support DCP.

d. GOES I-M Variable (GVAR). This downlink in the 1675-1710 MHz band is a direct broadcast of the processed Imager / Sounder data from the GOES satellites, and has been operating since 1987.

e. Other Applications. Potentially lesser known uses of the NOAA warning messages by non-federal users supported by transmissions in the 1675-1710 MHz band include non-weather emergency warnings, such as AMBER Alerts and Silver Alerts, which may be relayed over NOAA Weather Radio All Hazards at the request of local and/or state officials.[20] While Amber Alerts typically are relayed via the FCC's Emergency Alert System (EAS), terrestrial EAS transmitters are subject to being out-of-service, particularly during severe weather. In those instances, authorities rely on NOAA Weather Radio All Hazards for assistance. For example, the NWS Western Region reported in August 15, 2005, the Boise Idaho

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[20] *See* http://www.nws.noaa.gov/nwr.

Weather Forecasting Office was asked to issue an Amber Alert on Boise and Twin Falls NOAA Weather Radios. After issuing the alert, Idaho State Communications noticed that no local radio stations in the Boise area were re-broadcasting the alert. After troubleshooting, they realized their transmitter in the Boise area was not operating. The EAS message was transmitted throughout the rest of the state without problems, but broadcasters in the Boise area were unable to pick it up. Idaho State Communications quickly instituted their backup plan, which is to have the NWS issue the message using NOAA Weather Radio operating in the 1675-1710 MHz band.[21]

These networks carry "All Hazard" data, including broadcast warning and post-event information for all types of hazards, including natural events (earthquakes, volcanic, avalanches to include snow avalanche and debris flow), environmental disasters (such as chemical releases or oil spills, biohazards), fire incidents, nuclear incidents, terrorist activities and public safety (Amber Alerts or 911 Telephone outages).[22] Such data are transmitted in messages and warnings via the 1675-1710 MHz band satellite downlink. Interference-free "All Hazard" transmissions[23] are critical in situations where no Internet or VHF broadcast is available, no power is available, or failure or outages require a backup plan.

Item 4: Which portions of the 1675-1710 MHz band are used?

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21 *See* NOAA's National Weather Service Western Region Notes, September 8, 2005 – from Internet [www.nwsla.noaa.gov/wrh/staffnotes/092205internet.pdf]

22 www.weather.gov/directives/sym/pd01017008curr.pdf.

23 The acronyms used in this chart are explained in the Appendix. Note 47 C.F.R. § 2.1(c). The definition of "harmful interference" sets a lower threshold for harmful interference in the case of safety services relative to other services: "Harmful interference" is "[i]nterference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with [the ITU] Radio Regulations."

The following table summarizes domestic Meteorological Satellite (space-to-Earth) services operating in the band the FCC is examining.[24]

Satellite	Frequency (MHz)	Function	Date Bringing Into Use	Comment
GOES	1676.0	Mission Data Link	1994	
GOES	1681.478	Mission Data Link	1994	
GOES	1685.7	GVAR	1994	
GOES	1691	WEFAX/LRIT	1994	
GOES	1694	Telemetry	1994	
GOES-N	1676	Data	2006	
POES	1698	HRPT	1978	
POES	1702.5	HRPT / TIP / MIP	1978	TIP includes Argos DCS
POES	1707	HRPT	1978	
NPOESS/JPSS	1707	LRD	2015	
GOES-R	1696.3	Telemetry		
GOES-R	1697.4	LRIT HRIT & EMWIN		
GOES-R	1683.3	Data Collection Platform-Domestic		
GOES-R	1683.6	Data Collection Platform – Int'l		

Item 5: How often the service is used (*e.g.*, every day, scheduled times of day, duration, etc.)

Emergency warnings and near-real time weather information are monitored 24 hours per day, 7 days a week, and 365 days per year by non-federal as well as federal users. Warnings for severe storms, tornado warnings, tsunami warnings, and hurricane warnings where safety of life and property are involved are all time critical. The occurrence of such warnings

[24] A brochure on NOAA-N satellites is available at: http://www.osd.noaa.gov/POES/noaa_n.htm. A description of the GOES-R satellite is available at: http://www.goes-r.gov/overview/spaceArchitecture.html. Information about the NPOESS program is available at: http://www.ipo.noaa.gov/.

cannot be scheduled, and the need for users to access this information reliably and without gaps in coverage cannot be overestimated.

During severe weather events, power outages routinely occur and terrestrial and Internet communications are interrupted. Transmissions in the 1675-1710 MHz band direct from satellites may be the only dependable means of communicating vital safety information. Changing the allocation of the 1675-1750 MHz band to allow for shared mobile broadband use would severely impact the ability of non-federal and federal users reliably to receive these safety-related warnings throughout the United States. While expanding mobile broadband use will provide certain public benefits, the benefits derived from introducing those services in this particular band would be marginal in comparison to, and do not outweigh, the vast public interest benefits of emergency preparedness and other safety-related transmissions that a reallocation of the 1675-1710 MHz band would compromise. While the current non-federal and federal uses in this band are unique and irreplaceable, the spectrum made available in the 1675-1710 MHz band (assuming all 35 MHz are made available for broadband) would only account for a little more than 5% of the 500 MHz of spectrum that the mobile broadband industry requires according to the National Broadband Plan and the White House Broadband Initiative.

Item 7: A description of whether and how the information and services currently accessed can be obtained from other means

Although certain data described in the previous section may be available via the Internet or UHF broadcast in certain discrete areas, conventional services are often degraded during natural disasters, if they are not completely off-line. During emergency weather situations, radio and television stations go off-air, electrical outages significantly limit the availability of Internet access, and cell phone and landline telephone service are often not available in large geographic areas.

By way of example, on the island of Oahu, Hawaii, Internet fiber covers the island by means of pole-mounted facilities (*e.g.*, aerial fiber) as the water table and the geography prohibit burying fiber cable. The fiber ring infrastructure is reportedly often in close proximity to trees. In the event the island is subjected to a tsunami or a severe meteorological event, Internet access could be inoperable for many days, throughout much of Oahu. If the same OC-48 ring serves as the backbone for cellular services, such services would suffer a similar degradation or failure for an extended period of time.

The only viable, reliable source of safety-of-life warnings is the current satellite downlink in the 1675-1710 MHz band. Internet data distribution has no guarantee of timeliness, and it introduces additional points-of-failure into the reliability equation (*e.g.*, power availability, speed of servers, condition of the user's personal computer software, and usage in the event the connectivity is via shared means such as DSL). If an emergency manager uses EMWIN as a trigger for local emergency services sirens, the timeliness and reliability of receipt of this lifesaving data is critical. The L-band satellite downlink reduces the number of points of potential failure drastically.

Similarly, a rural emergency management organization may have a very limited alternative to the L-band satellite reception during a severe weather (*e.g.*, tornado) event. Storm debris or natural electromagnetic event (*e.g.*, lightning) can damage terrestrial infrastructure, delaying critical warnings. Coastal areas, in the proximity of where a hurricane makes landfall, also may experience degradation or interruption of traditional terrestrial or Internet services.

Further, the satellites in orbit as well as the satellites that are in the late stages of their design and production are committed to operation in the 1675-1710 MHz band. Satellite transmissions in this band will be present, with an active L-band downlink, even if a reallocation

to mobile broadband were to occur. Such transmissions, which comply with International Telecommunications Union recommendations on power flux density, would continue on current satellites. There is no means by which these satellites could be reprogrammed to operate on different frequencies, which would not be a solution in any event because users around the world rely on equipment that is designed to receive these data on these same frequencies as in the United States.[25]

Item 8: Confirmation that, if the information currently available from the meteorological satellite service were received at only a few receive sites and distributed via terrestrial services, this would be a functionally equivalent substitute for the direct reception of the satellite and radiosonde services

As discussed above, timely safety warnings for the general public and for specialized users cannot be provided by a "functionally equivalent substitute." Further, the protection of key receive sites is critical for the operation of the end-to-end infrastructure. In addition to operational sites involved in satellite control or mission data reception, key warning centers – such as NOAA's National Hurricane Center (Miami) or the Pacific Tsunami Warning Center / NOAA Pacific Regional Center (Oahu) must be protected from interference that would be created by spectrum sharing.

Any notion that if the information supporting current applications could be received at only a few protected sites and still yield equivalent public benefits reflects a misunderstanding of how the band is used today. Some applications involve data being broadcast, such as the NOAA PORTS® system, to cite one example, to many non-federal and federal receive sites using the subject frequency band. Ports in major U.S. cities rely on direct receipt of this data. Individual maritime users do not have the option of accessing the Internet for

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[25] *See discussion in* Comments of the World Meteorological Organization, ET Docket 10-123, June 24, 2010, at Annex 2, p.2.

these time-sensitive data; they must receive it in or near port. Significant investments have been made to be able to receive the data in the 1675-1710 MHz band. Today's commercial mobile radio service systems in other bands blanket the coastal areas around the United States. Any new mobile broadband systems allowed in the 1675-1710 MHz band would likewise move toward ubiquitous coverage and materially increase the potential for harmful interference within and in the proximity of major ports, where receipt of information from the PORTS® system is critical.

In determining whether to reallocate certain spectrum for shared use, the Commission should diligently evaluate the feasibility of sharing the desired frequencies taking into account the operating characteristics and usage patterns of the current and potentially new services. In the 1675-1710 MHz bands, a number of non-federal safety services relying on interference-free delivery of warnings and other data to myriad non-federal as well as federal users in real-time. These operating requirements place high constraints on any would-be new service. At a minimum, in this stage of its examination, the Commission should require commercial mobile broadband proponents to proffer compelling analyses and/or demonstrative evidence before it further considers initiating a rulemaking or otherwise recommending that the 1675-1710 MHz band can be used by mobile broadband devices without causing harmful interference to the current safety services. At this juncture, given the widespread reliance among numerous non-federal and federal users on the data transmitted by the systems described above, would-be mobile broadband service providers face a high burden.

Item 9: Any other information from interested parties would like to identify regarding use of the meteorological satellite and radiosonde services

Emergency management users often have limited budget and resources to meet their mission needs. Every L-band antenna, receiver and associated software on a personal

computer represents an investment of up to $1,500. Equipment in this cost range does not allow for extensive multi-stage filtering to minimize the effects of harmful interference. Raising the cost significantly by requiring such filtering systems may place the systems out of reach of many current users. If terrestrial broadband towers or portable and handheld transmitters in support of mobile broadband use are introduced in this band, the L-band electronics of the safety services will likely be subject to in-band or adjacent-band harmful interference. Additionally, such systems could find their Low Noise Blocks desensitized in the presence of high power RF energy. Adding expensive multi-stage RF filters to protect such systems, would negatively impact the link margin and the installation of such filters, in addition to increasing significantly the relative costs for emergency management users.

As a general comment, meteorological and environmental information, which is needed to create forecasts, requires adequate radio spectrum to meet key requirements. A significant percentage of sensor measurements from space (> 95% of total data) supported by local measurements from radiosondes and terrestrial measurements are required as input for supercomputers to perform numerical weather prediction. A global data set, measured by polar-orbiting satellites, is necessary for medium-term forecasting (approximately three to five days). Polar-orbiting sensors include active and passive sounders, and imagers using microwave and infrared wavelengths. These sensors profile the atmosphere, probe the near-space environment, and monitor the Earth's natural radiation budget to observe other atmospheric, terrestrial and oceanic phenomena globally. Measurements from geosynchronous satellites provide a mechanism to "stare" continuously at a specific portion of the planet, and those measurements provide equally important readings of temperature and moisture throughout the depth of the atmosphere and provide imagery using thermal profiling. Polar orbiting satellites monitor the

entire planet, a function which is increasingly important for long-term weather analysis and forecasts, as the data from geosynchronous satellites alone are inadequate for a comprehensive understanding of global conditions that affects the environment in all latitudes. As described earlier in these Comments, earth stations for polar-orbiting satellites must be able to point in all azimuths and at all elevations, increasing the odds that such earth stations will experience potential interference from terrestrial systems during certain pass-overs.

Radio spectrum needs (from beginning to end) required to create and distribute environmental data include:

- Spectrum to support active and passive measurements by the sensor in space
- Spectrum (space-to-Earth) to send the raw sensor data to Earth for processing (Mission Data Down link)
- Spectrum (space-to-Earth) for direct broadcast services, such as the services in the 1675-1710 MHz band
- Spectrum for subsequent relay and distribution of terrestrially processed data
- Spectrum for timely distribution of warnings and science data

There are many mechanisms available today to obtain the results of weather forecasts, specialized warnings and science products which illustrate the widespread benefits from systems using the 1675-1710 MHz band. These results may be seen by the general public on television and local meteorologists, or from access to satellite television, radio, internet web sites, wireless devices and text messages. The general public does not necessarily know or consider that these reports derive from NOAA satellite sensors in space and measurements made on the ground (or by aircraft) and from radiosonde measurements in the atmosphere, but this does not change the fact that 1675-1710 MHz transmissions are at the heart of many of these reports. Supercomputers analyze all these varied inputs to produce a weather forecast using advanced numerical weather prediction. Other computers generate products that support

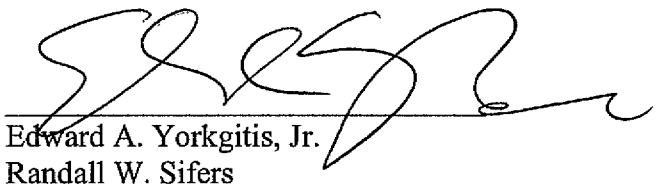
volcanic ash cloud warnings for aviation, hurricane or tsunami warnings, and dozens of other applications. These products all originate from NOAA supported systems available to non-federal as well as federal users, and everyone else derives their products from the information produced by these systems. Having adequate spectrum in the 1675-1710 MHz band – in which the relevant satellites in orbit transmit today – unaffected by harmful interference from in-band or adjacent-band services is critical to the production and dissemination of these NOAA services to all classes of users.

IV. CONCLUSION

As explained above, many non-federal users which do not require licenses and are not required to register their stations, but whose use is contemplated by currently deployed systems, rely on data downlinked in the 1675-1710 MHz band from satellites to low-cost receivers. Sharing this band with mobile broadband users will disrupt, degrade, or delay the transmission of critical safety-related data which is necessary for emergency planning, safety alerts, and other disaster related planning. For the reasons set forth herein, the Commission should decline further consideration of this band for commercial mobile broadband applications.

Respectfully submitted,

RAYTHEON COMPANY



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APPENDIX

Acronym List

The following acronyms were used in the tables in the Comments of Raytheon Company.

CDA	Command Data & Acquisition
CNES	Centre National d'Etudes Spatiales
DCP	Data Collection Platform
DCS	Data Collection System
EAS	Emergency Alert System
EMWIN	Emergency Managers Weather Information Network
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
GOES	Geostationary Operational Environmental Satellites
GVAR	GOES I-R Variable (Variable Format)
HRPT	High Rate Picture Transmission
LRIT	Low Rate Information Transmission
NASA	National Aeronautics and Space Administration
NESDIS	National Environmental Satellite, Data, and Information Service
NOAA	National Oceanic and Atmospheric Administration
NTIA	National Telecommunications and Information Administration
NWS	National Weather Service
OET	Office of Engineering and Technology
POES	Polar Orbiting Environmental Satellite
PORTS®	Physical Oceanographic Real-time System
VHF	Very High Frequency
WEFAX	Weather Facsimile